

## DETAILED ACTION

### *Response to Arguments*

1. Examiner acknowledges receipt of Applicant's Amendments, remarks, arguments received on 10/29/09. Applicant's arguments have been considered but are moot in view of the new ground(s) of rejection.

### ***Claim Rejections - 35 USC § 103***

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-9,14-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Inoue et al. (6798564) in view of Islam et al. (US 2003/0133179).

Considering Claim 1 Inoue discloses an optical fiber communication system comprising: silica fiber as a gain medium for Raman amplification to amplify a signal light(See Col. 6 lines 42-47, fig. 1 i.e. silica fiber(10) for a gain media for Raman amplification to amplify a signal light);a pumping light source that emits a forwarding pumping light that co-propagates through the silica fiber in the same direction as the signal light and pumps the signal light(See Col. 6 lines 52-54, fig. 1 i.e. a pumping light source(11) that emits forward pumping light that co-propagate with the signal light through the amplifying fiber(10)); and a multiplexer disposed between the silica fiber and the pumping light source that multiplexes the signal light and the pumping light(See Col. 6 lines 57-61, fig. 1 i.e. a multiplexer(13) for multiplexing the

**input signal with the pump light from pump light source(11)), wherein the multiplexer is provided with a means to multiplex the signal light input thereto having a wavelength longer than the zero-dispersion wavelength of the silica fiber and the pumping light emitted from the pumping light source(See Col. 12 lines 13-22, fig. 1,13 i.e. a multiplexer(13) for multiplexing the input signal having wavelength(~1480nm-1630nm) with a forward pump light from the pump light source(11)), and the pumping light source is equipped with a means to emit forward pumping light(See fig. 1 i.e. the pump light source(11) has a forward pumping light), with the longest wavelength of the pumping light being shorter than the shortest wavelength of the signal light so as to have a frequency difference of 13.7 to 17.9 THz(See fig. 23,25 i.e. as illustrated in fig. 16 the forward pumping light has a wavelength of 1385nm(fig. 25), and the shortest signal light has a wavelength of ~1480nm(fig. 23). Therefore the frequency difference is  $f=V/\Delta\lambda=3*10^8\text{m/s}/(1/1385\text{nm}-1/1480\text{nm})=13.9*10^{12}\text{Hz}=13.9\text{THz}$ ).**

Inoue discloses the input signal light has a wavelength approximately in the range of 1480-1630nm(See fig. 7).

Even though it is well known in the art that the zero dispersion wavelength of a silica fiber is around 1310nm.

Inoue does not explicitly indicate a zero dispersion wavelength the fiber.

Islam teaches a standard fiber has a zero-dispersion wavelength at 1310nm(See Paragraph 119 i.e. the zero dispersion wavelength of a standard single mode fiber is 1310nm).

Therefore it would have been obvious to consider the zero dispersion range of the single mode fiber used in Inoue(See fig. 7) has a zero-dispersion around 1310nm.

Since the incoming signal light has a wavelength range of 1480nm-1630nm(See Islam: fig. 7), this incoming signal wavelength range(1480nm-1630nm of fig. 7) is longer than the zero dispersion wavelength of a similar silica single mode fiber(1310nm).

Considering Claim 2 Inoue does not explicitly disclose the optical fiber communication system in accordance with claim 1, wherein the silica fiber is a dispersion-shifted fiber, and the signal light comprises a plurality of wavelengths in the L band.

Islam teaches the optical fiber communication system in accordance with claim 1, wherein the silica fiber is a dispersion-shifted fiber(See Paragraph 137, fig. 6 i.e. the transmission fibers are DRA(Distributed Raman Amplifier). As further discussed in Paragraph 137, the Raman amplifiers made in dispersion-shifted fiber), and the signal light comprises a plurality of wavelengths in the L band (See Paragraph 128 i.e. since the L-band covers wavelength in the range of 1530-1610nm and the signal light has wavelength 1550nm, the signal light is included in the L-band).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Inoue, and have the silica fiber to be a dispersion-shifted fiber, and the signal light to comprise a plurality of wavelengths in the L band, as taught by Islam, thus providing an efficient transmission system by reducing non-linearity effect in the transmission medium using a dispersion shifted fiber to minimize noise and signal loss, as discussed by Islam (Paragraph 20).

Considering Claim 3 Islam teaches the optical fiber communication system in accordance with claim 1, wherein the silica fiber is a non-zero dispersion-shifted fiber(See Paragraph 180,181, fig. 6 i.e. a NZ-DSF transmission fiber), and the signal light comprises a plurality of wavelengths in the C band(See Paragraph 21,128 i.e. **since the C-band includes wavelength in the range of 1530-1565nm and the signal light has wavelength 1550nm, the signal light is included in the c-band**).

Considering Claim 4 Islam teaches the optical fiber communication system in accordance with claim 1, wherein a remotely-pumped double-pass EDF module is provided at a signal light output stage of the silica fiber, and the wavelength of the pumping light is not less than 1430 nm and not more than 1470 nm(See Paragraph fig. 12b i.e. **EDFA is provided in a bidirectional transmission fiber near the output stage where the wavelengths of the second pumping unit is in the range of about 1450-1470nm**).

Considering Claim 5 Islam teaches the optical fiber communication system in accordance with claim 1, wherein a remotely-pumped single-pass EDF module is provided at a signal light output stage of the silica fiber, and the wavelength of the pumping light is not less than 1440 nm and not more than 1470 nm(See Paragraph fig. 12b i.e. **EDFA is provided in a bidirectional transmission fiber near the output stage where the wavelengths of the second pumping unit is in the range of about 1450-1470nm**).

Considering Claim 6 Islam teaches the optical fiber communication system in accordance with any one of claims 1 through 5, wherein the pumping light source is a

laser diode with a fiber Bragg grating or a fiber laser(See Paragraph 188, fig. 39 i.e. the pumping source is equipped with different light emitting diodes(3902-3912) and Bragg-gratings(3922-3932)).

Considering Claim 7 Islam teaches the optical fiber communication system in accordance with claim 2 or claim 3, wherein when the minimum value of the wavelength of the signal light is  $\lambda_s$ , the minimum value of the zero-dispersion wavelength of the silica fiber is  $\lambda_0$ , and the maximum value of the wavelength of the pumping light from the pumping light source is  $\lambda_p$ , the wavelength of the signal light, the zero-dispersion wavelength, and the wavelength of the pumping light are set so that  $2\lambda_0 - \lambda_s > \lambda_p$ (See Paragraph 144,fig. 12A i.e. the zero dispersion wavelengths( $\lambda_0$ ) is 1524nm,1533nm,1536nm; and the incoming signal( $\lambda_s$ ) is about 1550nm(see fig. 12A); and the maximum pump wavelength( $\lambda_p$ ) is about 1450nm. Therefore,  $2\lambda_0 - \lambda_s > \lambda_p \Rightarrow 2(1524\text{nm}) - 1550\text{nm} > 1450\text{nm} \Rightarrow 1498\text{nm} > 1450\text{nm}$ ).

Considering Claim 8 Islam teaches the optical fiber communication system in accordance with claim 7, wherein the pumping light source is a multiwavelength laser diode with a fiber Bragg grating or a Fabry-Perot laser diode(See Paragraph 188, fig. 39 i.e. the pumping source is equipped with different light emitting diodes(3902-3912) and Bragg-gratings(3922-3932)), and the wavelength of the signal light, the zero-dispersion wavelength, and the wavelength of the pumping light are set so that  $2\lambda_0 - \lambda_s > \lambda_p + 10$ (See Paragraph 144,fig. 12A i.e. the zero dispersion wavelengths( $\lambda_0$ ) is 1524nm,1533nm,1536nm; and the incoming signal( $\lambda_s$ ) is about 1550nm(see fig.

**12A); and the maximum pump wavelength( $\lambda_P$ ) is about 1450nm. Therefore,  $2\lambda_0 - \lambda_S > \lambda_P + 10 \Rightarrow 2(1524\text{nm}) - 1550\text{nm} > 1450\text{nm} + 10 \Rightarrow 1498\text{nm} > 1450\text{nm} + 10$ ).**

Considering Claim 9 Islam teaches the optical fiber communication system in accordance with claim 7, wherein the pumping light source is a fiber Raman laser, a laser diode with a single-wavelength fiber Bragg grating, a laser diode with a multiwavelength fiber Bragg grating, or a Fabry-Perot laser diode(See Paragraph 188, fig. 39 i.e. the pumping source is equipped with different light emitting diodes(3902-3912) and Bragg-gratings(3922-3932)), and the wavelength of the signal light, the zero-dispersion wavelength, and the wavelength of the pumping light are set so that  $2\lambda_0 - \lambda_S > \lambda_P + 15$ .(See Paragraph 144,fig. 12A i.e. the zero dispersion wavelengths( $\lambda_0$ ) is 1524nm,1533nm,1536nm; and the incoming signal( $\lambda_S$ ) is about 1550nm(see fig. 12A); and the maximum pump wavelength( $\lambda_P$ ) is about 1450nm. Therefore,  $2\lambda_0 - \lambda_S > \lambda_P + 15 \Rightarrow 2(1524\text{nm}) - 1550\text{nm} > 1450\text{nm} + 15 \Rightarrow 1498\text{nm} > 1450\text{nm} + 15$ ).

Considering Claim 14 Islam teaches the optical fiber communication system in accordance with claim 2 or claim 3, wherein a power spectrum of the signal light is set so that the power of the signal light input to the silica fiber decreases the further to the short wavelength side where the Raman gain due to the Raman amplification is large(See Paragraph 127 i.e. the shorter wavelength has a large power at the beginning of the transmission line, however the high power shifted from the short wavelength to the long wavelength down the transmission line. This shows that the power of the short wavelength side decreases down the transmission power).

Considering Claim 15 Islam teaches the optical fiber communication system in accordance with claim 1, wherein the silica fiber is silica fiber laid throughout a city (**See Paragraph 3 i.e. optical fibers for broad band communications**).

Considering Claim 16 Islam teaches The optical fiber communication system in accordance with claim 1, wherein the silica fiber is silica fiber for lumped optical amplification(**See fig. 12,35 i.e. optical fiber for lumped optical amplification**).

Considering Claim 17 Islam teaches the optical fiber communication system in accordance with claim 1, wherein the wavelength of the signal light is a single wavelength(**See fig. 17 i.e. a signal light source having a single wavelength which is ~ 1550nm**), with the difference between the wavelength of the signal light and the longest wavelength of the pumping light being, in terms of a frequency difference, 15.6 THz or more(**See Paragraph 183 i.e. the co-propagating pump(first pump) has a shorter wavelength than the incoming signal by a frequency of 26.4 THz**).

1. Claims 10,18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Inoue et al. (6,798,564) in view of Islam et al.(US 20030133179) in view of Mitsuda et al. (5,936,763).

Considering Claim 10 Inoue and Islam disclose a channel spacing of less than 10 nm(**Islam: Paragraph 163**).

Islam does not specifically disclose the optical fiber communication system in accordance with claim 8, wherein the width of the multiwavelength is 10 nm or less

Mitsuda teaches the optical fiber communication system in accordance with claim 8, wherein the width of the multiwavelength is 10 nm or less(**See Col. 3 lines 38-41**,

**Col. 5 lines 35-40, fig. 1 i.e. the channel width of a multiwavelength pumping sources is less than 10nm).**

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Inoue and Islam, and have the multiwavelength to have a width of 10 nm or less, as taught by Mitsuda, thus providing an efficient transmission system by narrowing the width of each channel so that the number of transmitted channels can be increased as well as the output power resulting many users can be concurrently serviced by the optical communication system, as discussed by Mitsuda (col. 4 lines 66-Col. 5 line 2).

Claim 18 is rejected for the same reason as in the claim 10.

2. Claims 11,19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Inoue et al. (6,798,564) in view of Islam et al.(US 20030133179) in view of Wai et al. (20040184491).

Considering Claim 11 Inoue and Islam do not specifically disclose the optical fiber communication system in accordance with claim 8, wherein the pumping light source is provided with a variable attenuator on an output side of a polarization multiplexing Fabry-Perot laser diode to adjust an output of the pumping light from each Fabry-Perot laser diode pumping light

Considering Claim 11 Wai teaches the optical fiber communication system in accordance with claim 8, wherein the pumping light source is provided with a variable attenuator on an output side of a polarization multiplexing Fabry-Perot laser diode to adjust an output of the pumping light from each Fabry-Perot laser diode pumping



light(See Paragraph 91, fig. 3 i.e. **a light source is provided with a variable attenuator to adjust the output signal on an outside of a Fabry-Perot Laser diode**).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Inoue and Islam, and have the pumping light source to be provided with a variable attenuator on an output side of a polarization multiplexing Fabry-Perot laser diode to adjust an output of the pumping light from each Fabry-Perot laser diode pumping light, as taught by Wai, thus providing an efficient transmission system by providing a variable attenuator to control and stabilize the output power of a rapidly changing state of polarization, as discussed by Wai (Paragraph 5).

Claim 19 is rejected for the same reason as in the claim 11.

3. Claim 12, 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Inoue et al. (6,798,564) in view of Islam et al.(US 20030133179) in view of Yokota et al. (6,424,459).

Considering Claim 12 Inoue and Islam disclose the optical fiber communication system in accordance with claim 2 or claim 3, wherein the optical fiber communication system has an erbium-doped fiber amplifier having: an erbium-doped fiber gain block provided with erbium-doped fiber as a gain medium(See Islam: Paragraph 121,fig. 12a i.e. **erbium doped fiber amplifier provided as a gain medium**); a gain equalization optical filter disposed before or after the erbium-doped fiber gain block(See Islam: fig. 10 **a filtering unit is provided with the gain medium**); measuring the gain performance of the amplifying unit and a dispersion compensating fiber for

compensating for compensating based on the determined performance of the fiber(See **Islam: Paragraph 145,146)**

Inoue and Islam do not explicitly disclose a population inversion detection circuit that measures a population inversion amount in the erbium-doped fiber; and a population inversion adjustment circuit that controls the erbium-doped fiber gain block so that the population inversion amount measured by the population inversion detection circuit is a prescribed value.

Yokota teaches a population inversion detection circuit that measures a population inversion amount in the erbium-doped fiber; and a population inversion adjustment circuit that controls the erbium-doped fiber gain block so that the population inversion amount measured by the population inversion detection circuit is a prescribed value(See Col. 5 line 66-Col. 6 line 11, Col. 3 lines 4-10,Col. 6 lines 52-58, fig. 3 i.e. **measuring the population inversion amount in EDF amplifiers and adjusting the output power of the EDF amplifiers based on the determined gain**).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Inoue and Islam, and have a population inversion amount in the erbium-doped fiber to be measured; and a population inversion adjustment circuit that controls the erbium-doped fiber gain block so that the population inversion amount measured by the population inversion detection circuit is a prescribed value, as taught by Yokota, thus providing an efficient transmission system by controlling the gain of each EDF for broadening a wavelength region where a flat wavelength characteristic gain is obtained, as discussed by Yokota (Col. 2 lines 21-26).

Considering Claim 13 Yokota teaches the optical fiber communication system in accordance with claim 12, wherein the excited-state filling factor  $N_2$  of the erbium-doped fiber is less than 38%.

According to Paragraph 142 of the specification of the current application, "...the excited-state filling factor  $N_{sub.2}$ , which is the population inversion amount, being 42%, 40%, 38%, 36%, and 34%. In FIG. 16, the horizontal axis represents wavelength (nm), while the vertical axis represents gain (dB). As is clear from FIG. 16, the flat gain is approximately 20 dB in the L band when the excited-state filling factor  $N_{sub.2}$  is 38%..."

Similarly, Yokota teaches a population inversion factor near 38% for an L-band of EDFA having a population inversion factor near 38%(See Col. 6 lines 6-9, fig. 3).

### **Conclusion**

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to HIBRET A. WOLDEKIDAN whose telephone number is (571)270-5145. The examiner can normally be reached on Monday to Friday from 8:00 a.m. - 4:00 p.m..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Vanderpuye can be reached on 5712723078. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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